

REMARKS

Claims 10, 12-24, 26-27, and 29-31 are amended. Claims 1-9, 11, 25, and 28 are canceled. Claims 32 and 33 are new. Support for the above amendments and new claims is found at the original claims and pages 36, line 25 to page 37, line 2, page 27, lines 6-20, page 35, lines 23-27, page 13, line 10, page 14, lines 6-17, page 14, line 25 to page 15, line 8, page 14, lines 25-27, page 15, lines 5-8, and page 35, line 25 to page 37, line 2, of the specification. No new matter is believed to be introduced by the above amendment.

At the outset, Applicants thank Examiner Lish for the helpful discussion of the present invention held on July 14, 2003, and the helpful comments provided in the outstanding Office Action. Further, Applicants thank the Examiner for indicating that the above amendments combined with the following remarks appear to further favorable prosecution of the present invention.

The rejections of the claims under 35 U.S.C. § 102 and/or § 103 over JP 09-029097 (JP'097) alone or in any combination with EP 0734086 (EP'086) are believed to be obviated by the above amendment combined with the remarks below.

JP'097 discloses, at best, a catalyst for reforming by the use of steam. However, JP'097 fails to disclose or suggest a method wherein oxygen is fed under the condition that a ratio of the oxygen to the feedstock is fed to the reaction system that is from 0.1 to 1.0 in terms of the number of oxygen molecules / the number of carbon atoms in the feedstock.

In contrast, the present invention relates to a method for autothermol reforming by the use of oxygen and steam which comprises contacting a feedstock with a catalyst comprising ruthenium supported on zirconia, or comprising ruthenium supported on an inorganic oxide carrier. In addition, the present amended Claims 17 to 31 are related to a method for reforming by the use of carbon dioxide which comprising ruthenium supported on zirconia, or zirconium and ruthenium supported on an inorganic oxide. Further, the oxygen is fed

under the condition that a ratio of the oxygen to the feedstock is fed to the reaction system that is from 0.1 to 1.0 in terms of the number of oxygen molecules / the number of carbon atoms in the feedstock.

When the claimed autothermal reforming reaction is conducted, or reforming is conducted by the use of carbon dioxide using the catalyst in the present invention, such excellent performances as a high conversion and also no deterioration in efficiency, even if used for a long period of time, can be obtained. This is clearly supported in view of Examples in the present specification and the Declaration submitted on January 9, 2003.

The Office relies on EP'086 for apparently disclosing a catalyst containing ruthenium to be used for the reforming by the use of steam and for CO₂. Further the Office contends that EP'086 discloses a reaction to produce the same substance from hydrocarbon using such a catalyst. However, the EP'086 does not disclose or suggest autothermal reforming.

In contrast, the catalyst of the present invention is useful for an autothermal reforming. Further, in a case of a reforming reaction using CO₂, the present invention suppresses caking and it is possible to obtain a synthetic gas having a ratio H₂/CO of 1 (See the present specification, page 53, and page 34, line 3).

Furthermore, in general, cokes are liable to accumulate in case of the reforming reaction by the use of CO₂ is conducted by merely applying a steam reforming catalyst, even though activity is similar between both of the two. (See reference explanation described below).

Even if a catalyst for use in the reforming reaction by the use of CO₂ is used as a catalyst for a conventional reforming by the use of steam, in general, a lot of carbon will deposit. Further, H₂/CO ratio in the resultant gas will become much smaller than 1. Thus, conventional reforming can not obtain the superior effects of the present invention. In

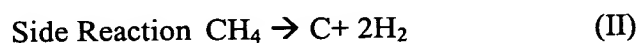
support of such facts, Applicant provide herewith three references, including translations thereof that will be explained below.

1. Japanese Patent Application Laid Open No.08-175805; (disclosed in the present specification, page 4, line 15)

The catalyst of Ni/Al₂O₃, disclosed in Comparative Examples 2 to 4 and the catalyst of Rh/Al₂O₃ disclosed in Comparative Example 1 in JP No.08-175805 (see col. [0034] and [0038]) are well known as a steam reforming catalyst [for example, see Japanese Patent Application Laid Open No.09-075728 attached hereto]. However, if these catalysts are used for the reforming by the use of CO₂, carbon-accumulation will become rapid. (see col. [0039], Table 1). For that reason, in Examples 1 to 4, a depositing speed of carbon is improved and suppressed by using a carrier having 5 coordination Al³⁺ (see col. [0039], Table 1). Thus, it is not effective to use the catalyst, for use in reforming by the use of CO₂.

2. Japanese Patent Application Laid Open No.09-075728; (disclosed in the present specification, page 4, line 15)

This reference describes that when a Ni/Al₂O₃ catalyst disclosed is used in the reforming reaction by the use of CO₂, carbon deposit due to the following side reaction (III) will increase, and the ratio of H₂/CO of the gas obtained by the side reaction (III) will remarkably be less than 1 (col. (00031 and [00041).



Further, even in case of the catalyst using the element of the VIII group in the Periodic Table together with the rare earth element which improves the carbon amount to be

deposited, (disclosed in col. [00061 as a conventional technology referred to, Japanese Patent Application Laid Open No. 1-148343 attached hereto), the side reaction (II), (III) will occur at the same time with the main reaction (The fact will be explained below in more detail).

Namely, it is clearly impossible to obtain the synthetic gas with the ratio of H_2/CO being near to 1, due to the reason that; such side reaction (III) will occur when the reforming by the use of CO_2 is conducted and applying Ni/M_2O_3 catalyst.

3. Japanese Patent Application Laid Open No.1-148343; (disclosed in JP No.09-075728)

The catalyst contains, as an active element, the element of the VIII group in the Periodic Table (Fe, Co, Ni, Pd, Rb, Ru, Ir) and the rare earth element, and the carrier is comprised of a rare earth or Al_2O_3 . Such a catalyst is employed in both of the reformings by the use of steam and CO , (see the second and third phrases in the "Means for solving the Problem")

However, in the reforming reaction by the use of CO_2 (in Example 16), where the catalyst $Ru-Y_2O_3$ was used, and wherein the catalyst $Ru-Al_2O_3$ was used (Comparative Example 8), the ratio of H_2/CO was less than 1 as follows (Table 8).

$Ru-Y_2O_3$ (Example 16)

$H_2/CO = 0.12$ (500°C), 0.28 (600°C)

$Ru-Al_2O_3$ (Comparative Example 8)

$H_2/CO = 0.27$ (500°C,) 0.15 (600°C)

In light of the above, it is impossible to obtain a synthetic gas with the ratio of H_2/CO being near to 1, even though such catalyst as $Ru-Y_2O_3$ or $Ru-Al_2O_3$ system, which is useful for the reforming reaction by the use of steam is merely applied to the catalyst for the reforming by the use of CO_2 .

The above facts demonstrate that the above-mentioned side reaction, represented by the formula (III), described in Japanese Patent Application Laid Open No. 09-075728 has likely occurred.

Stated differently, Japanese Patent Application Laid Open No. 09-075728 discloses that coking will occur using a Ni system catalyst, and Japanese Patent Application Laid Open No. 1-148343 discloses that coking will occur using a noble metal system catalyst.

In contrast thereto, in case when the reforming process by the use of CO_2 is carried out using the catalyst according to the present invention, coking can successfully be suppressed, and further, a synthetic gas with the ratio of H_2/CO being 1 can efficiently be obtained.

In light of the above, JP'097 does not disclose or suggest the claimed invention. Further, EP'086 not only fails to disclose or suggest the claimed invention, but also fails to provide what JP'097 lacks. Accordingly, no combination of JP'097 with EP'086 discloses or suggests the claimed invention, and withdrawal of these grounds of rejection is respectfully requested.

The rejection of the claims under 35 U.S.C. § 112, is believed to be obviated by the above amendment and the following remarks. The claims have been amended to satisfy that the preamble matches the body therein. Further, "as reduced to ZrO_2 " was originally intended to mean that the content of Zr is converted into the content of ZrO_2 including the content of non-formed ZrO_2 . Further, the description "as reduced to MgO " was intended to mean similarly. Further, the claims have been made definite by defining the mixing ratio of a starting material, oxygen, steam and carbon dioxide, and therefore, it is noted that these Claims should not be rejected. Withdrawal of these grounds of rejection is respectfully requested.

Application No. 09/701,585
Reply to Office Action of March 7, 2003

Applicants respectfully submit that the present application is now in condition for allowance. Should anything further be required to place this application in condition for allowance, the Examiner is requested to contact the Applicants' attorney by telephone.

Respectfully submitted,

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MAIER & NEUSTADT, P.C.

A handwritten signature in black ink, appearing to read 'Norman F. Oblon', with a stylized flourish extending to the right.

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